Aalto University
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THE EFFECT OF ECB'S PANDEMIC EMERGENCY PURCHASE PROGRAM TO EUROPEAN CORPORATE BOND YIELDS

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Abstract

I assess the effect of European Central Bank's Pandemic Emergency Purchase Program (PEPP) to the European corporate bond yields in the secondary market during the year 2020. I find evidence suggesting that bonds eligible to the program experienced significantly larger decrease in yield spreads (swap spreads) after the initial announcement of the purchase program (announcement effect) as well as after the start of the ECB's purchases (direct effect). The announcement effect after the third PEPP announcement in December 2020 is completely different as eligible bonds increased more in yield spread.

Keywords PEPP, ECB, Corporate Bond, QE, Pandemic Emergency Purchase Program

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List of abbreviations used

Abbreviation	Explanation
ECB	European Central Bank
PEPP	Pandemic Emergency Purchase Program
PSPP	Public Sector Purchase Program
CSPP	Corporate Sector Purchase Program
APP	Asset Purchase Program

SWSP	Swap Spread (Reuters)
QE	Quantitative Easing
OMT	Outright Monetary Transactions
EAPP	Extended Asset Purchase Program
ABSPP	Asset-Backed Securities Purchase Program
CISS	Composite Index of Systemic Stress (ECB)
LTRO	Long-Term Refinancing Operation
TLTRO	Targeted Longer-Term Refinancing Operations
PELTRO	Pandemic Emergency Longer-Term Refinancing Operations
LSAP	Large-Scale Asset Purchases
SMCFF	Secondary Market Corporate Credit Facility
ASW	Asset Swap
IG	Investment Grade
HY	High-Yield
MBS	Mortgage-Backed Securities
EUREP	Eurosystem Repo Facility
FED	Federal Reserve System

1 Introduction

In the middle of the historical Covid-19 Pandemic, ECB responded strongly by announcing the largest asset purchase program in the history of European monetary collaboration. Even though Covid-19 is first and foremost an unprecedented healthcare crisis, it has affected both the supply and demand of goods and services across the economies and the financial conditions around the world. With the policy interest rates close to the effective lower bound, the central banks around the world are forced to rely on unconditional monetary policy measures to restore healthy economic conditions and ensure the effective transmission of monetary policy. The most important part of European Central Bank's Covid-19 response is the Pandemic Emergency Purchase Program (PEPP) that consists of purchases of both public and corporate debt securities. ECB was one of the first central banks to announce its purchase program on March 18th, 2020.

The purpose of this paper is to study the effect of the Pandemic Emergency Purchase Program to European bond yields. I focus solely on the corporate bond -leg of the purchase program and study all the three PEPP announcements (March, June and December). I divide the effect on three parts: *Announcement effect*, *Direct effect* and *Portfolio rebalancing effect. Announcement effect* should occur immediately after the purchase program announcement as new information is incorporated into the corporate bond prices. I find significant announcement effects for the March and June announcements. The March announcement is also economically large as the yield decreasing effect of eligibility is 27% with a three-day event window. In this context, eligibility means that an individual bond can be purchased by ECB within the frames of this purchase program. The yield decreasing magnitude of the June announcement is more muted (8%) although highly significant. The December announcement produced highly significant yield increasing effect of 5%. I find multiple possible reasons why the third announcement did not produce yield decreasing effect for the eligible bonds as the prior two announcements did. These reasons include for example less distressed economic environment and other important, and simultaneous, announcements made by ECB. The third event is discussed thoroughly at the end of the paper.

Direct effect occurs when ECB fulfills the expectations set up by the initial PEPP announcement, and actually buys some eligible corporate securities. I find evidence strongly supporting yield decreasing direct effect for my sample of eligible bonds. My regression results suggest yield decreasing direct effects, starting from fifty days after the March event (1%) and growing in magnitude all the way until 230 days after the announcement (17%) for the purchased bonds. These results however are not statistically significant, likely due to a very small sample size of actually purchased bonds. The median yield change during 2020 is also the most negative for the sample of eligible bonds that are included in ECB's portfolio. Those bonds decreased in yield spread 65% on average. This is significantly more than the yield spread decrease of "eligible but not bought" bonds (52%) and non-eligible bonds (45%).

The portfolio rebalancing effect should close the yield change gap created by the first two effect in the longer term. By purchasing eligible bonds and effectively increasing the demand for those bonds, the central bank lowers the yield of those eligible assets. Yield-seeking investors should in theory decrease their exposure to those lower-yielding assets and increase their exposure to some riskier, higher-yielding, assets. However, I find no significant evidence to support this effect.

The remaining of the paper is organized in the following manner: I first go through ECB's monetary policy tools and prior operations in the second section. In the third section, I conduct a thorough literature review, after which I present my hypotheses. The fourth section describes the data and fifth section the methods that I use. In the sixth section I report the results of my analysis for every three effects separately. In section seven I examine the robustness of the results followed by discussion of the results in section eight. The section nine concludes the paper.

2 Overview of ECBs operations

2.1 ECB's monetary policy objectives and tools

The primary objective of the ECB's monetary policy is to maintain price stability across euro area. ECB states that this is the best way to ensure the economic growth and job creation in the euro area. In practice "price stability" means maintaining inflation rate below, but close to, 2% over the medium term. The standard monetary policy tools include for example open market operations, standing facilities and minimum reserves. Non-standard measures include outright monetary transactions, forward guidance, long-term refinancing operations and asset purchase programs. This paper will focus on exclusively on the latter. All the general information regarding European Central Bank's monetary policy objectives and tools as well as previous operations is retrieved from ECB's website.

2.2 ECB's quantitative easing operations

In January 2015 ECB began implementing major quantitative easing to the euro area. Quantitative easing (QE) is an "unconventional" form of monetary policy where central bank creates new money in order to buy financial assets such as government bonds and thus increases the amount of money in circulation in the economy. These QE actions are taken to support the monetary policy transmission mechanisms and ensure price stability. The objectives are meant to be achieved through multiple transmission channels. The central bank signals to markets that it will keep the interest rates low for an extended period and by purchasing assets it will provide market participants extra money. By lowering the yields of the bonds that are eligible for the purchase program, ECB will encourage market participants to rebalance their portfolios into riskier assets such as high-yield corporate bonds and equities.

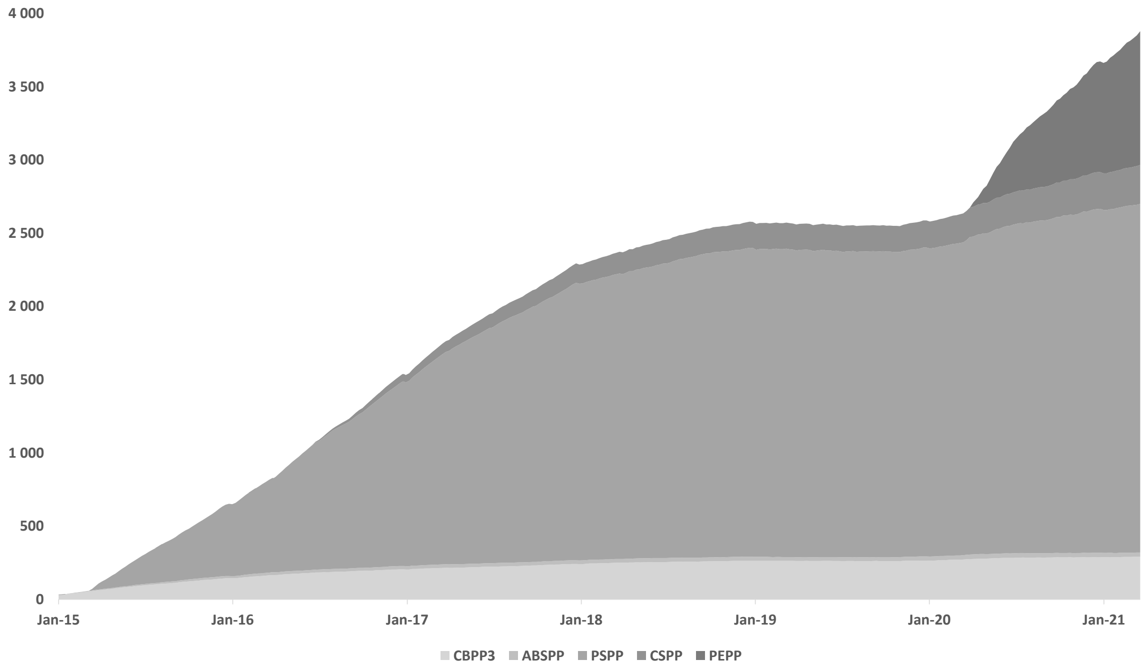
ECB has been buying bonds even before the launch of QE in 2015. For example, Outright Monetary Transactions -program (OMT) was presented in 2012 after Mario Draghi's famous commitment to do "whatever it takes" to preserve the Euro. ECB conducted the OMT to decrease the cost of borrowing for a set of countries whose borrowing costs were considered to be too high. In both cases, QE and OMT, the European Central Bank is buying bonds with newly created money, but the objectives and means are different and thus OMT operations are not considered as quantitative easing.

European Central Bank's first asset purchase program was called Expanded Asset Purchase Program (EAPP), which included the purchases of government bonds (under PSPP), asset-backed securities (under ABSPP) and covered bonds (under CBPP3) issued by European institutions. Later, the program was renamed as Asset Purchase Program (APP). In March 2016 ECB announced a further expansion to its Asset Purchase Program, the Corporate Sector Purchase Program (CSPP), which aimed to further on strengthen the transmission of the monetary policy, enhance the financing conditions, and lower the yields of the targeted bonds. CSPP included the outright purchases of euro area investment-grade corporate bonds from both primary and secondary markets. This was the first time ECB bought non-bank corporate securities. Via portfolio rebalancing channel ECB also expected this to lower the yields of non-eligible bonds such as high-yield bonds and smaller bonds.

The cumulative assets owned by the central banks around the world have been in rise since the 2008 financial crisis. Central banks have launched numerous purchase programs to stimulate the economy, which has accumulated assets to their balance sheets. I report the cumulative net assets purchased by European Central Bank in the Graph 1. As we can see, the balance sheet has expanded radically since the launch of quantitative easing in 2015. As of April 2021, the total balance is closing in on four trillion euros. The purchases of government bonds under PSPP represent the vast majority of the holdings and the government bonds form the largest part of PEPP purchases too.

Graph 1

ECB's asset holdings by purchase program (in B€). The contribution of PEPP is displayed with the darkest color on top of all the other programs.

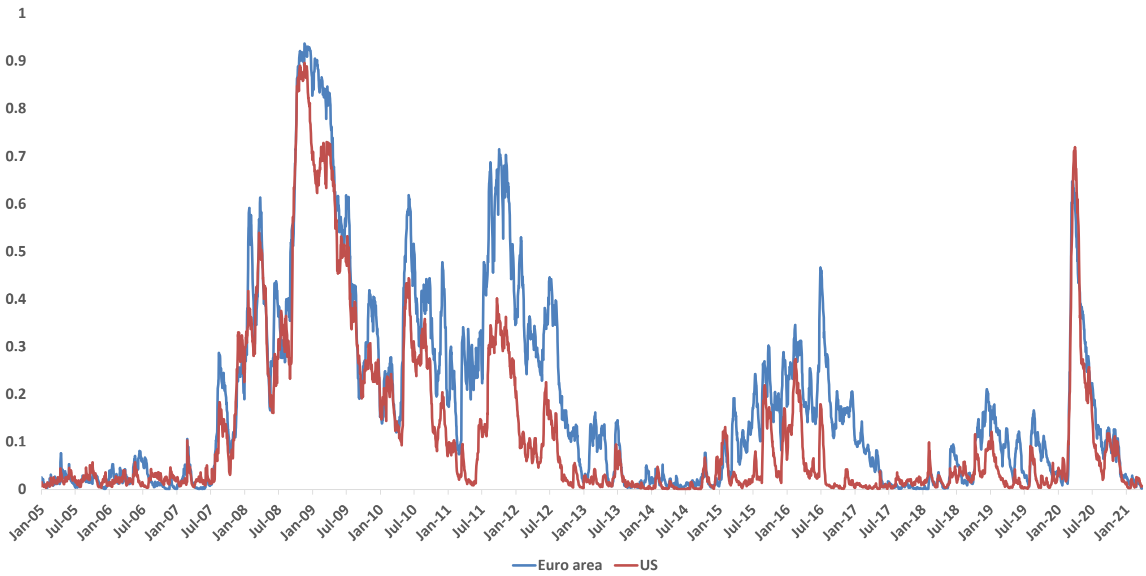


2.3 Pandemic Emergency Purchase Program

In March 2020, ECB announced another non-standard purchase program called the Pandemic Emergency Purchase Program (PEPP), in response to the COVID-19 Pandemic outbreak. PEPP is meant to counter the serious risks that the pandemic causes to the monetary policy transmission mechanism. The pandemic had, at the time of the launch of the program, seriously worsened the economic conditions in the EU and the expectations of the future were not exactly positive either. The pandemic threatened almost every business no matter the sector or pre-pandemic financial stability. The Composite Index of Systemic Stress (CISS) is known to reflect well the pressure an economy is brought to bear on. It includes 15 market-based financial stress metrics such as realized market volatility and bond and interest rate spreads. I report a timeseries of CISS data for the euro area and the US in Graph 2. Last time those two economies were exposed to as high levels of systemic stress was November 2011 for the euro area and April 2009 for the US. Of course, in 2011, euro area was amid a surging sovereign debt crisis and in 2009 the whole world was suffering from global financial crisis. All the data and information regarding CISS is retrieved from ECB's Statistical Data Warehouse (SDW).

<u>Graph 2</u>

This graph reports the time-series for the Composite Index of Systemic Stress for US and euro area from 2005 onwards.



Pandemic Emergency Purchase Program is a temporary program that buys both public and corporate bond securities. The initial magnitude of the purchase program was 750B€, which was meant to be used until the end of 2020. On June 4th, 2020, ECB announced an expansion and an extension to this program. The total scale of the program now was 1350B€ and the weekly purchases were meant to be continued at least until March 2021. On December 10th, 2020, the program was once again expanded, this time to 1850B€, and the purchase horizon extended to March 2022. This is the state of the purchase program as of writing this in July 2021.

The eligibility criteria for PEPP are almost identical to the eligibility criteria of CSPP and PSPP with some exceptions related to the maturity criteria. From this point onwards, this paper will focus on exclusively to the corporate bond leg of the purchase program. To gain eligibility to the program, a corporate bond must fulfill the following criteria:

Sector: non-financial

Currency: Euro

Country: euro area

Maturity: initial more than 365 days and remaining between 0,5 and 31 years OR initial less than or equal to 365 days and remaining more than 28 days

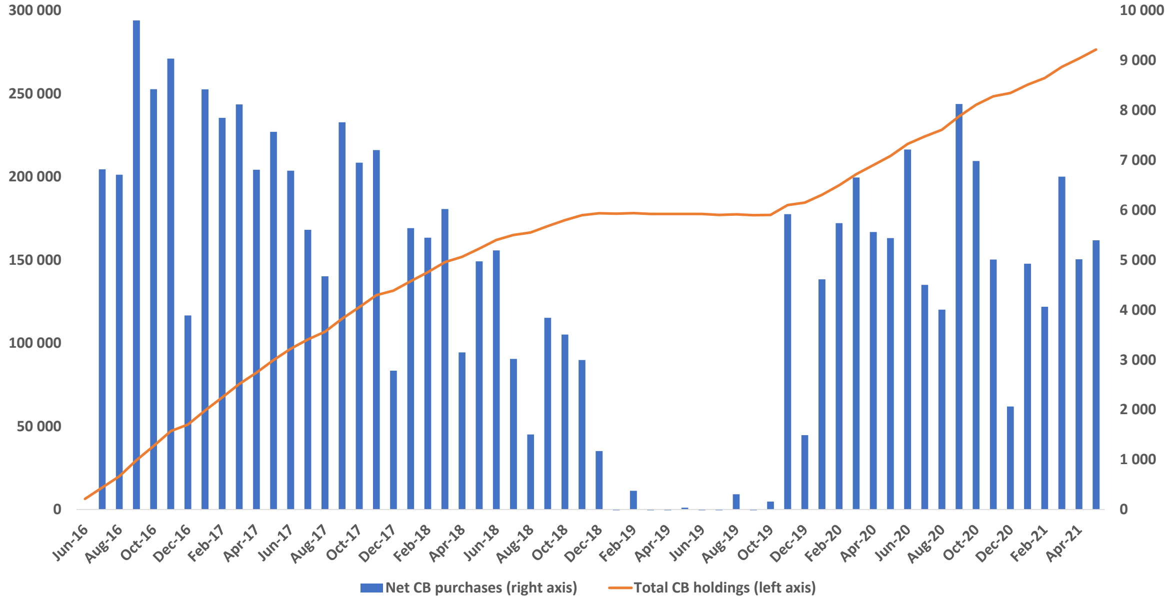
Volume: minimum 10M€

Rating: investment grade (BBB- or better)

The Pandemic Emergency Purchase Program is officially an individual purchase program but ECB reports all its corporate bond holdings under the broader Corporate Sector Purchase Program (CSPP). To get a grasp of the magnitude of the corporate bond leg of PEPP, we need to compare the monthly net purchases of corporate sector bonds before and after the initial PEPP announcement. In Graph 3, I report ECB's monthly net corporate bond purchase volumes and the total amount of the holdings for the past five years. Since the start of PEPP the average monthly net purchases of corporate bond securities (5,4B€) have been four times higher than the last twelve months before the program (1,4B€). PEPP has more than ten-folded the monthly volume of corporate bond purchases compared to year 2019 (0,5B€). Compared to the full history of ECB's corporate bond purchase era the current monthly net purchases are 24% higher than average. ECB's total corporate bond holdings have increased by 2,3% per month after the announcement of the program. This accounts for a total increase of 32,0% in ECB's corporate bond holdings during the last 10 months of the year 2020. Although the corporate bond purchases account for only about three percent of all the PEPP purchases the increase in corporate bond purchase volume is significant. All the portfolio holding data is retrieved from ECB's website.

<u>Graph 3</u>

This graph reports the time-series for ECB's monthly net corporate bond purchases (right axis) and the cumulative corporate bond holdings (left axis) from May 2016 to March 2021. All figures are in M€.



3 Literature review and hypotheses

3.1 Theoretical bond pricing channels

Quantitative easing affects the bond yields via many different channels. Krishnamurthy and Vissing-Jorgensen (2011) present seven channels: signaling channel, duration risk channel, liquidity channel, safety channel, inflation channel, credit risk channel and pre-payment risk premium channel. Next, I will quickly go through a few of these channels to better understand the theory behind bond yield movements.

Signaling channel only has effect on yields if the central bank's promises to keep interest rates low for an extended period etc. are convincing. This channel affects all types of bonds but has largest impact on mid-term maturities.

Duration risk is a risk an investor bears when holding a fixed coupon debt instrument and thus is exposed to the changes in interest rates. This channel naturally has the largest effect on bonds with longest maturities. Central banks can decrease the duration risk by buying long-maturity instruments. "Preferred habitat theory", a theory that there is a subset of investors that prefer certain maturities, enhances this channel since the arbitrageurs are bearing the duration risk in exchange for a premium. Longer maturity bonds are more sensitive to interest rate risk. This is also the reason why generally the purchase programs that target longer maturity bonds are more effective: central bank purchases of long-term bonds should reduce private sector's "exposure to duration risk and thus lead to a decline in yields".

The *liquidity channel* is active when central banks purchase assets from investors and therefore increase the supply of money. QE increases the liquidity in the hands of investors and decreases the liquidity premia of assets, especially the premia of less-liquid assets. Liquidity channel may be the most important transmission channel of the quantitative easing programs. In theory, over-purchasing of certain securities could even decrease their liquidity as central banks act as passive holders of those securities. This would then also increase the liquidity premia of those securities.

The *default risk channel* is effective if the purchase programs can stimulate the economy properly and enhance the operating environment of companies, so that fewer firms go bankrupt. This should lower especially the yields of bonds with intermediate credit ratings.

3.2 The three phases of yield movement

This study does not focus on the theoretical bond pricing channels, but rather on the actual yield effects of PEPP. Previous purchase programs have affected the bond yields in multiple different ways. In this study I divide the yield effect into three "phases" based on empirical evidence provided by prior studies: the announcement effect, the direct effect, and the portfolio rebalancing effect. Zaghini (2017) discusses the effects of CSPP in similar form, using all three phases of the phenomenon. Other prior studies have also examined the first two effects, announcement and direct effect, as separate and individual effects. I will discuss the findings of prior literature in the next subsection in more detail.

The *announcement effect* occurs when some information that will affect the future is revealed, and markets adjust to that. In the financial markets this can be observed when for example companies give indication of their future earnings estimates or when central banks change their key policy interest rates. Additional information is provided, and the markets are adjusting to that. Purchase programs are generally seen as positive signs of central banks trying to improve the economic conditions, which should in a vacuum yield a positive reaction. Markets of course can expect some actions and therefore even a positive action from the central bank can be seen as lackluster and the market reaction can be negative. In efficient markets the current prices contain all the available information including expectations of the future.

The effect on asset prices that happens when someone fulfills the expectations is what I call the *direct effect*. In the context of this study, the direct effect occurs when the European Central Bank actually buys some of those eligible bonds it has promised to buy by announcing the program. When conducting the purchase of a given bond the ECB increases the demand of that bond and therefore its price will naturally increase. Actual purchases can also be seen as a further confirmation of the purchase program actually taking place. In corporate finance world this can happen for example when a firm actually pays dividends that it has announced in the past.

The *portfolio rebalancing effect* is the third effect studied in this paper. By increasing the demand of eligible bonds, the central bank lowers the yield of those eligible assets. Yield-seeking investors might therefore decrease their exposure to those lower-yielding assets and increase the exposure to some riskier, higher-yielding, assets. This pattern is first described by Tobin in 1958. The transition is most likely to happen inside the corporate bond asset class and between bonds with similar duration risk. Krishnamurthy and Jorgensen (2011) find out that the role of duration appears through a “preferred-habitat” demand for particular bond maturities. Additional yield is the return for bearing some additional credit risk. Mishkin (1996) also argues that portfolio rebalancing channel assumes some frictions in the market, typically preferred habitat or market segmentation, that preclude perfect arbitrage between maturities and permit changes in the maturity composition of nominal government debt to affect asset prices. In theory, the portfolio rebalancing effect should lower the yield change gap created by the previous two effects. ECB is of course aware of this effect and the increased allocation to riskier assets is in fact critical to the overall success of the purchase programs. For example, the euro area banks and institutional investors holding the eligible bonds are incentivized to transfer to riskier assets including equities and riskier debt securities such as loans to households and firms. This should effectively increase lending to private sector and stimulate the economy.

The timing of rebalancing effect is however hard to predict and the causality between the purchase program and the portfolio rebalancing effect is harder to study. The total substitutability of two duration-wise similar assets affects to which extent the rebalancing effect occurs. In practice it might be hard to only increase the exposure to credit risk without altering the exposure to other risk factors. This market imperfection or market segmentation might lower the portfolio rebalancing effect or slow it down.

If ECB were to over purchase some debt securities, they could actually even decrease the liquidity of the purchased assets, even though the goal of purchase program is to increase liquidity. Liquidity could decrease in the case that ECB owns and holds too large portion of the outstanding volume of a certain security. This could in theory create a liquidity premium, that the investors would require in exchange for holding those eligible assets. This would have a yield increasing effect for those eligible bonds. This topic of interest is however outside the scope of this study and will not be discussed going forward.

3.3 The effects of the previous purchase programs

Prior studies find significant announcement effects on ECB's non-standard monetary policy measures. Some papers also study the direct and portfolio rebalancing effect. Depending on the paper, the direct effect is sometimes also referred to as "flow effect" and portfolio rebalancing effect either "portfolio effect" or "asset valuation channel". Most of the literature is naturally concentrated around the public securities purchase programs since majority of QE has been conducted via government bonds both in Europe and in the US.

Altavilla et al. (2015) find an economically significant and immediate effect after the two PSPP announcements in 2015 to sovereign bonds across the Europe. The decline in yields is about 30-50 basis points depending on the country and the "window's size", which refers to the length of the measurement period. The effect was largest for Spanish and Italian sovereign bonds and more muted for French and German bonds. Altavilla et al. had to control for pre-event effects because the markets were expecting QE announcements. The effect was viable already one day after the announcement due to the high liquidity of the sovereign bond secondary market. Altavilla et al. do not consider the possible direct effects in the paper nor the portfolio rebalancing effect.

Andrade et al. (2016) find that all of the yield effects are produced upon the announcement of PSPP, and that no statistically significant effects can be identified when the actual purchases of eligible bonds are carried out. The overnight announcement effects found by Andrade et al. are 14 to 32 basis points for sovereign bonds depending on the country, 10 percentage points for investment grade bonds and 13 basis points for high yield bonds. The direct effect is estimated to be around 16 basis points upon implementation, although not significant. Andrade also finds evidence that clearly supports the so called "asset valuation channel", which I call portfolio rebalancing channel. Andrade estimated the overall effect of APP to be roughly comparable to a decrease of one percentage point in the policy interest rate. Andrade et al. (2016) also conducted an exhaustive literature review, and based on the 26 papers analyzed, the median announcement effect for APP was 43 basis points decline in yields.

Zaghini (2017) studies the primary market effects of ECB's first corporate bond purchase program CSPP back in March 2016. The author does not document any significant primary market announcement effect. Zaghini finds a strong direct effect of the purchases to eligible bonds during the first nine months after the announcement: the eligible bonds experienced a decline of 118 basis points in yield spread in the primary market while non-eligible bonds experienced a slight increase in yield spread. In 2017 the difference between eligible and non-eligible bond yield changes vanished. This is consistent with the portfolio rebalancing channel.

Krishnamurthy et al. (2017) and Altavilla et al. (2014) find a significant announcement effect as a reaction to ECB's Outright Monetary Transactions (OMT) in 2012. OMT announcement caused quick and rather large effects on Spanish and Italian government bond yields. The bonds with already low yield levels, such as German and French government yield remained practically unchanged. De Santis (2016) report similar results regarding the announcement of ECB's Asset Purchase Program (APP) in 2015. Krishnamurthy et al. (2017) use 2-day yield change to also measure the announcement effects of various government bond purchase programs such as SMP, OMT and LTRO's and find the programs to significantly reduce especially the yields of riskier sovereign bonds.

Gagnon et al. (2011) find economically large announcement effects to Fed's LSAP. The reaction to the announcement was visible immediately after the announcement in the government bond yields. Fawley and Neely (2013) evaluate the effect of the Fed's 2008-09 QE on international long bond yields and exchange rates, showing that the effects are consistent with the portfolio rebalancing effect.

3.4 How PEPP should affect bond yields?

The target of this program is of course to improve the economic conditions in the euro area. ECB tires to achieve this by lowering the yields of the eligible bonds and through rebalancing channel also indirectly decreasing the yields of other securities such as non-eligible bond yields. This should help easing the funding conditions of firms and maintain their operative capabilities. The actual purchases, and perhaps the announcement of the program too, should also improve the liquidity of the corporate bond market. The direct effect is caused by ECB entering the market with large buying power. The "behavioral effect" could be caused via signaling effect: the assumption or expectation of ECB entering the market could encourage investors to buy eligible and perhaps non-eligible bonds too.

Regarding the effect on bond yields the prior literature gives mixed predictions. Zaghini (2017) studies primary market reaction to CSPP announcement and actual purchases. Zaghini finds a strong direct effect after actual purchases but not a significant announcement effect. Zaghini also finds evidence of portfolio rebalancing channel; the yield change gap between eligible and non-eligible bonds vanished during the second year of primary bond issuance after the announcement.

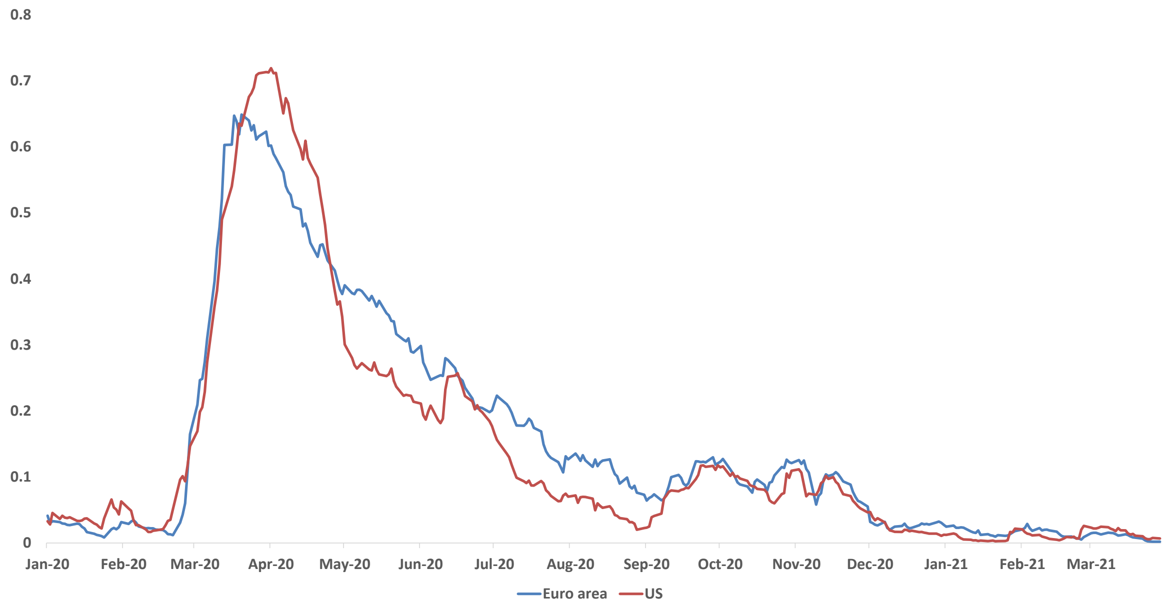
However, many other studies such as Altavilla et al. (2016), Andrade et al. (2016) and Krishnamurthy et al. (2017) suggest that the announcement effect (sometimes also referred to as "stock effect") comprises a majority of the full effect and that the magnitude of the direct effect (also referred to as "flow effect") is relatively muted. For some earlier reference, Joyce and Tong (2012) show this to be true for the UK and D'Amico and King (2012) for the US. This suggests that the monetary policy signaling channel is working efficiently, markets are absorbing information and the information transfers to bond yields quickly.

Kargar et al. (2021) studied the effect of Fed's SMCFF program during the Covid-19 pandemic from the bond liquidity perspective. They exploit the SMCFF eligibility criteria to find that eligibility had a positive effect on corporate bond liquidity. Kargar et al. document that the cost of trading increased dramatically during the first pandemic wave and that the Fed's purchase program had a positive effect on market liquidity. The authors emphasize that unlike many economic shocks, this one is a fully external one meaning that liquidity did not cause the shock but rather the other way around.

If the Composite Indicator of Systemic Stress is to be trusted, the central bank actions on both sides of the Atlantic convinced the markets in the short term. The Graph 4 below shows the time-series of that indicator for euro area and US from the beginning of 2020. The initial announcement of PEPP took place 18th of March and immediately after that the indicator dropped significantly. Fed announced its response to the Covid-19 pandemic on 23rd of March in the form of a purchase program announcement (SMCCF). It took a couple of days for the US indicator to decrease but eventually it did as well. I have every reason to expect this reaction to also be evident in the corporate bond yields if the markets in fact were convinced by the actions of the central banks.

Graph 4

This graph reports the time-series for Composite Index of Systemic Stress for US and euro area from 2020 onwards.



3.5 Hypotheses

Bonds that are eligible for the ECB's Pandemic Emergency Purchase Program should benefit from the program more than non-eligible bonds. This effect should come in two phases: the initial announcement effect for all eligible bonds and the "direct" effect when ECB actually conducts purchases of eligible bonds. The rationale behind these hypotheses is that by purchasing certain assets ECB increases the demand for those assets and thus increases their price and decreases their yield. The announcement effect should work efficiently as a sign of trust towards ECB and its purchase program. However, over time this effect should revert back at least in some magnitude: Investors will seek additional yield from other assets and thus increase the supply of eligible bonds. This portfolio rebalancing effect should shrink the yield change gap between eligible and non-eligible bonds that was created by the first two effects.

I will concentrate my analysis mainly to the announcement effect and compare the yield spread changes of eligible versus non-eligible bonds. My first and most important hypothesis therefore is that,

1. *Eligible bonds will experience a relatively larger decrease in yield spreads compared to non-eligible bonds after the PEPP announcements.*

Direct effect occurs when the European Central Bank actually fulfills the expectations set by the launch of the program and buys eligible bonds. When conducting the purchase of a given bond the ECB increases the demand of that bond and therefore its price will naturally increase. Actual purchases may reveal additional information of the purchase program such as the more specific scope of the purchases. Purchases could also further convince the markets that ECB is fulfilling the expectations set by the launch of the program. As a whole, the purchases of many eligible bonds should lower the average yield spread of the eligible bonds and widen the yield change gap between eligible and non-eligible bonds even more. My second hypothesis is that,

2. *The actual purchases of eligible bonds conducted by ECB will further widen the yield change gap between eligible and non-eligible bonds.*

By increasing the demand for eligible bonds, the central bank effectively lowers the yield of those eligible assets. Yield-seeking investors might therefore decrease their exposure to those lower-yielding assets and increase the exposure to some riskier, higher-yielding, assets. This should result in an increased demand for riskier bonds but also increase the demand for other asset classes, such as equities. In this study I will concentrate my analysis on bonds and analyze whether this effect does narrow the yield change gap between eligible and non-eligible bonds. The third and final hypothesis of this study therefore is that,

3. *Portfolio rebalancing effect should narrow the yield change gap between eligible and non-eligible bonds initially created by the announcement and direct effects.*

I also form alternative hypotheses for all three null hypotheses presented above. Alternative hypotheses predict that eligibility does not have any yield changing effect upon announcement, after the actual purchases conducted ECB or through the portfolio rebalancing mechanism.

4 Data

4.1 Overview of the data

I use European secondary market corporate bond data for this study. In order to qualify for the sample, the bond has to be denominated in Euros, have been initiated by a non-financial corporation domiciliated in Eurozone and be active as of the first event date (that is March 18th, 2020). This set of criteria gives me a total of 13 070 unique bonds. The sample reduces later a lot due to the various availability constraints set to the dependent and independent variables. I will then divide the sample into two subsamples: Eligibles and Non-eligibles. Eligible bonds fulfill all the eligibility criteria that I report in section 2.3.

My secondary market bond data is from Thompson Reuters Datastream. The dependent variable "SWSP" is the individual bond's spread to the swap curve with matching maturity and currency. The spread is expressed as yield difference, bond yield minus swap rate, in basis points. In other words, SWSP is the reference distance from a "risk-free" asset with similar maturity. I am mainly interested in the relative changes and therefore use percentage changes in the spread, that I call "deltas", "yield changes" or "yield spread changes". Many reference studies, such as Zaghini (2017) and Andrade et al. (2016), use some measure of spread to evaluate the yield changes. SWSP allows me to make more accurate comparison between bonds with different maturities and focus on the underlying credit risk of the bond rather than the duration risk or other risk factors. The "matching process" between a bond and a swap spread might not be perfect and therefore it is useful to still control for the remaining maturity of the bonds in the analysis.

I chose to use secondary market bond data to find out the possible effects of PEPP to bond yields. Some other studies, such as Zaghini (2017), prefer primary data for the liquidity reasons. Bao et al. (2011) argue that European secondary bond market prices and yields are significantly impacted by the illiquidity of the bonds. This could cause some bias to my analysis because I measure the effects of the purchase program through the changes in corporate bond yields. However, primary data would be hard to use for this study because of the need of accurate and timely data. By using secondary data, I managed to get a very large sample (more than 1 500 bonds), which will increase the explanatory power of the statistical tests. Secondary market covers larger scale of issuing corporations even though some of the bonds could be fairly illiquid. Secondary market data is also timelier and thus can be analyzed less than a year after the initial announcement of the program. For the purposes of this study, it was crucial to get a large sample of timely data that does not exclude any type of bonds regardless of the liquidity.

The median bid-ask spread for the full sample is 0,48% during from March 2020 to the end of year 2020. Naturally, the eligible bonds had smaller median spread (0,38%) compared to the non-eligible bonds (1,00%). On average terms the spreads were 0,99% for the full sample, 0,55% for the eligible sample and 1,97% for the non-eligible sample. The averages are pretty much in line with the European Bid-Ask Spread Index that reports value-weighted bid-ask spreads for European bonds. The index reports 0,71% spread for March (1,28% for HY and 0,54% for IG), 0,83% for June (1,54% and 0,64%) and 0,71% for November (1,19% and 0,57%). The average of my non-eligible sample is larger than the HY index spread, and the average of my eligible sample is smaller than the IG index spread. Here we all must remember that “eligible” does not equal “IG”, but the sample construction is rather a sum of three variables: bond grade, volume and maturity. All in all, the liquidity of the corporate bond sample is naturally limited but the secondary market data allows us to make an early assessment of the purchase program with large sample of corporate bonds.

I find there to be a significant increase in median bid-ask spread before the initial PEPP announcement. During the prior five days the spread increases from 0,38% to 0,54%. After the event, the bid-ask spread moves only slightly around the 0,55% level. This empirical finding is in line with Kargar et al. (2021) who report significant increase in the cost of trading around the height of the crisis in the US corporate bond market. I would also like to further on highlight the key message of Kargar et al. (2021): The economic shock caused by the Covid-19 Pandemic was a truly external shock, meaning that the shock affected liquidity and not the other way around. Therefore, decreased liquidity is one of the symptoms of the crisis and will and should affect the bond prices itself. Liquidity is one of the bond pricing channels and central banks are consciously using it to counter the negative effects of the pandemic. Illiquidity is not so much a problem for my analysis but rather an integral part of the yield spread changes generated by ECB’s actions.

All but one major control variables are also retrieved from Datastream. The “Already Holding Dummy”, which is a dummy variable expressing whether the ECB’s CSPP/PEPP portfolio already holds some amount of the bond or not, is retrieved from ECB’s Statistical Data Warehouse (SDW).

I use the latest 2020 bond rating available for each individual bond since I was not able to get a time-series data of bond ratings. The primary rating agency that I use is Fitch, but I use Standard & Poor’s or Moody’s data in case Fitch rating is not available for a given bond.

4.2 Descriptive statistics of the data

The two samples, eligible and non-eligible bonds, have very different yield spread patterns as Table 1 shows. The average spread of an eligible bond is only 15 to 18 percent of the average non-eligible bond spread during the 2020 period. The median spread difference is even more dramatic: Eligible bond median spread is only 13 to 15 percent out of the non-eligible one. The three bond characteristics listed in Table 1 might explain part of the difference in the level of the spreads. Eligible bonds are on average issued by larger companies in terms of total assets and those bonds are also larger in terms of initial issuance volume. Eligible bonds also had more maturity left as of event 1, but maturity should not have a large effect on spreads since the spread itself is a function of the bond yield minus the swap rate of the matching maturity. The spreads should thus be “maturity-corrected”.

Table 1

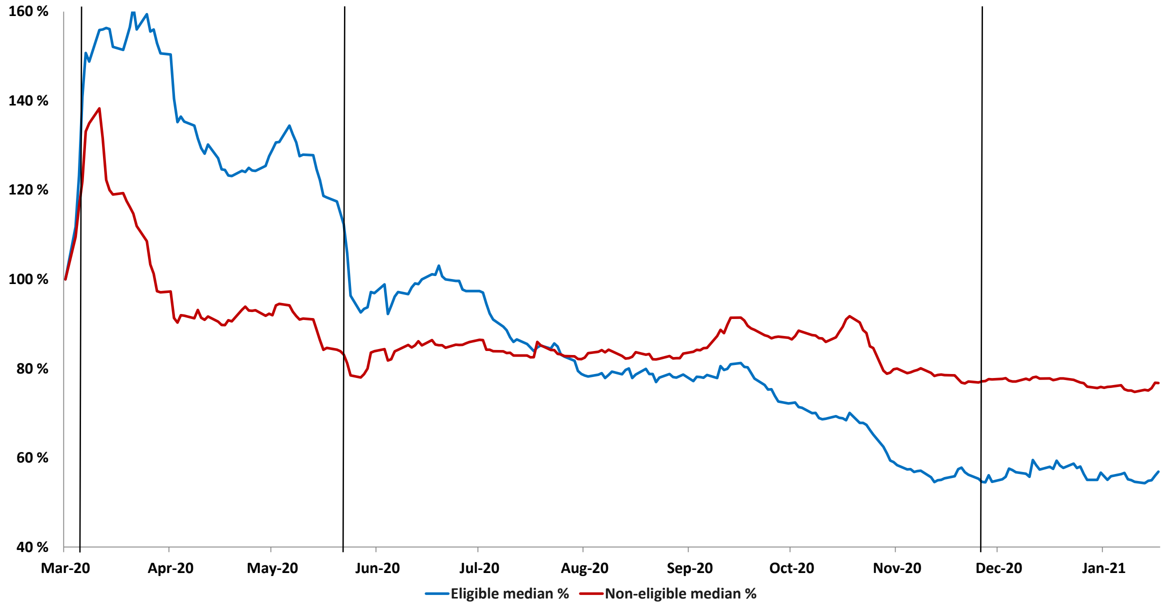
This table shows some descriptive statistics of the data used in this paper. All spreads are in basis points over the appropriate swap curve. The three control variables have some missing datapoints. In this table the eligible and non-eligible bonds are divided into their respective categories based on their eligibility as of March 2020.

	March 2020		December 2020	
	Eligible	**Non-eligible**	**Eligible**	**Non-eligible**
N	1 069	502	1 046	432
Mean spread	101	567	64	413
Median spread	88	475	51	379
10th percentile spread	33	102	25	145
90th percentile spread	190	1 081	142	781
Mean Total Assets (M$)	50 867	28 907		
Mean Volume (M$)	652	586		
Mean Maturity Left (E1, Days)	2 217	1 379		

The median spreads of the two samples, eligible and non-eligible, did both decrease from March to December 2020. In basis point terms, the median non-eligible bond spread decreased even more (100 basis points) than the median eligible bond spread (38). In relative terms this story is different. The median non-eligible bond had four times the spread of the median eligible bond in the beginning of the period. This multiplier grew to almost 7x by the end of 2020. The median eligible bond spread decreased by 43% and median non-eligible bond spread by only 21%. I report the evolution of the median yield spreads for both samples in Graph 5 showing also the three announcement dates with black vertical lines.

Graph 5

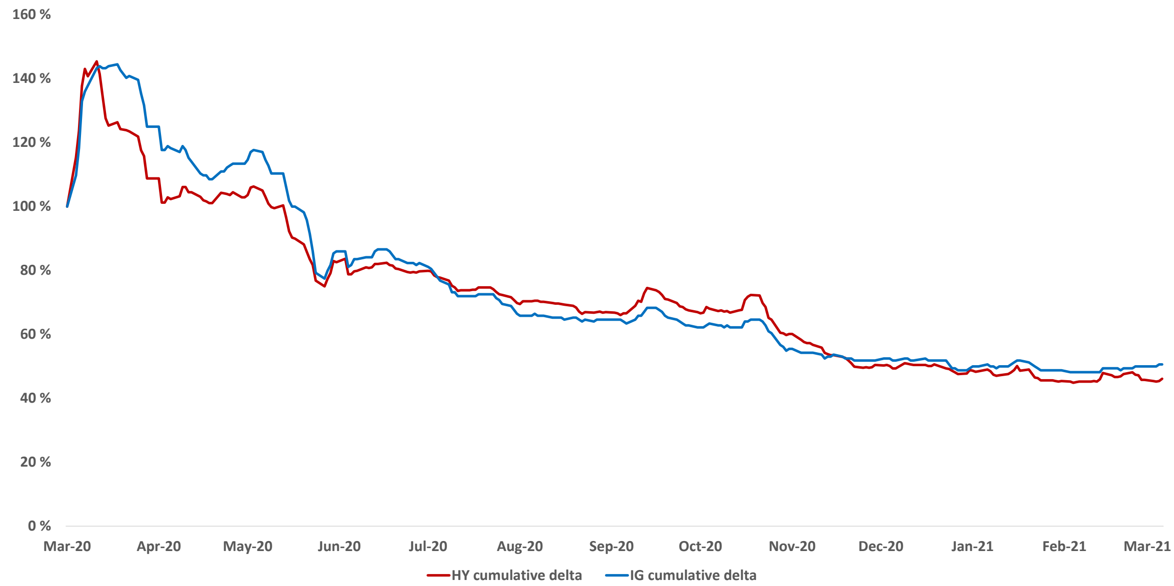
This graph shows the evolution of median bond spread for eligible and non-eligible samples from March 2020 to January 2021. Both samples are assigned a value of 100 five days before the first PEPP announcement in March 2020. Black vertical lines indicate the events (announcement dates).



In contrast to the yield changes of eligible and non-eligible samples I report the implied yield changes for European investment grade and high yield indexes below in Graph 6. As we can see from the graph, both indexes experienced almost identical yield changes after a twenty-day period after the first PEPP announcement. The yields of those two indexes decreased about 50% during the 2020. Yield change seems to be mostly independent of bond rating during the year 2020. That said, the eligible corporate bonds in my sample experienced way larger decrease in yield over the course of the year 2020 as visualized above in Graph 5. Therefore, if the bond's credit rating does not explain more than a small portion of the difference in yield change pattern, there has to be some additional factors favoring the bonds in my eligible sample over the bonds in my non-eligible sample. This is where the eligibility as a function of fulfilling multiple criteria comes into play. Only the combination of fulfilling the certain criteria seems to create the gap between the two samples. This suggest that eligibility matters even if the bond rating does not.

Graph 6

This graph shows the evolution of implied yield changes of European investment grade and high yield bond indexes. Time series start from five days prior to the initial PEPP announcement and cover 12 months after that. The indexes here are S&P Eurozone Investment Grade Corporate Bond Index and ICE BofA Euro High Yield Index. The yield changes are derived from option-adjusted spread and effective yield values.



5 Methods

5.1 Welch's t-tests for means in yield changes after announcements

I conduct Welch's two-sample t-tests for all the yield spread change patterns of individual bonds after PEPP announcements. I do this analysis to find out whether the yield spread changes after PEPP events are significantly different for eligible and non-eligible samples. Welch's two-sample t-test accounts for the differences in sample variances, unlike Student's t-test, and can thus be used to compare the means of these two samples regardless of the variances.

However, Welch's t-test still assumes normality. I conduct Shapiro-Wilk tests for the normality of the samples and find out that the data samples are likely not to be normally distributed. Most of the p-values generated by the Shapiro-Wilk tests are very small (most of the time smaller than 1e-15). I conduct this test for all the yield change patterns for three different time periods (6-day, 30-day and 50-day) and for all three events. All the time periods discussed in this study are in calendar days, not trading days. None of the data samples appear to be normally distributed. My data has adequate sample sizes, so the results are relatively trustworthy.

Regardless of the fact that my data is likely not to be normally distributed, I conduct the Welch's t-tests for three PEPP events (March 13th, June 4th, and December 10th, 2020) and use three different time frames of six, thirty and fifty days. For example, the six-day yield spread change after the first event is calculated as a percentage increase or decrease of the yield spread during the first six days after the event, starting from the closing yield spread one day prior to the event. This yield spread change is calculated for all the bonds and Welch's t-test is then applied.

I expect to find significantly more negative yield spread changes for my eligible samples. This does not mean that all eligible bonds should experience negative yield spread changes after all events, but rather that eligible bonds should experience relatively more decreasing or less increasing yield spread patterns. After some events, the general economic environment could be unfavorable and thus all the bonds could experience increasing yield spreads. This analysis does not give us any explanation of the reasons of the yield spread changes, it only tells us whether the two samples experience significantly different yield spread changes. I do not control for any categorical differences between the samples in this analysis.

5.2 Multivariable regressions for yield changes after announcements

As previously stated, the bonds in my two samples are very different from each other by many measures. I use the following multivariable formula to account for the heterogeneity in bond characteristics:

$$\mathbf{SWSP_i = \alpha_0 + \sum_k \boldsymbol{\beta}_k V_{i,k}^{bond} + \boldsymbol{\beta}_s prior\ 5day\ delta_I + fx(country, sector, rating)}$$

The dependent variable "SWSP" is the percentage change in the yield spread of a given bond. As earlier described, the swap spread is the individual bond's yield spread to the swap curve with matching maturity and currency. The spread is expressed as yield difference, bond yield minus swap rate, in basis points. In other words, SWSP is the reference distance from a "risk-free" asset with similar maturity. I call the percentage changes of the spread "deltas", "yield changes" or "yield spread changes".

The bond features (V^{Bond}) are the k variables describing bond features. These include *Eligible dummy* (1 if the bond fulfills all eligibility criteria as of event date and 0 if not), *Maturity Left* (remaining maturity in days as of event date), *Already Holding Dummy* (1 if the bond is included in ECB's CSPP/PEPP portfolio as of event date and 0 if not) and *Volume M$* (initial volume of the bond in millions of dollars).

Prior 5-day delta is a lag variable expressing the percentage yield spread change during five days before an event. This variable should capture the possible pre-event yield change that could occur due to leaked information, insider trading or market expectations.

This multivariate regression formula is a modification of the econometric approach first proposed by Sironi (2003) and used by others such as Zaghini (2017) to study the effects of central bank purchase programs. Modifications had to be done due the data availability constraints, secondary market fitting and the multi-event approach of this paper.

I run multivariate regressions for all three events and for multiple timespans from one to fifty days. As an example, I can run a multivariate regression for the six-day yield spread change for the first event. This will reveal the contributions of the selected regression variables to the six-day yield spread development. Very long-term analysis, such as one year delta, cannot be conducted because of the timing of this study. The latest of the three events happened at the time I started writing this thesis.

The main variable of interest is *Eligible dummy*, which should separate the effect of eligibility and eventually answer to my research question of whether the eligible bonds experienced a relatively larger decrease in yield spread compared to non-eligible bonds after the announcements. I control for all the eligibility criteria, to find out the combined effect of fulfilling all the criteria and thus being eligible for the purchase program. For both maturity and volume, I have specific variables and bond rating is included to the regression as fixed effects for every single unique rating. Those individual variables should capture the yield effect in case a bond fulfills only some of the three criteria. As previously stated, *Eligibility dummy* is practically a variable constructed by multiplying three dummy variables, Eligible (in terms of rating), Eligible (in terms of volume) and Eligible (in terms of maturity) with each other. As a result, *Eligible* Dummy only has the value of 1 if a bond satisfies all the eligibility criteria.

Some bond feature variables need a little more justification for their inclusion in the formula. *Volume* is probably one of the more straight-forward ones to justify. Volume is usually strongly related to liquidity and liquidity has bond pricing implications. *Remaining maturity* is not perhaps as intuitive and argument could be made that maturity or remaining maturity should only affect the level of the bond yield spread, because of duration risk channel, and not the change of yield. The swap spreads, that I am using, also are meant to be “maturity-corrected”. However, as stated earlier, the “matching process” of the swap contracts and bonds might not be perfect. Prior studies using swap spreads as a measure of yield (for example Zaghini (2017) and Andrade et al. (2016)) have also included some type of maturity control variable in their regressions. Maturity is also linked to the eligibility criteria and therefore is not exclusively a linear but also a binary variable in my analysis. An individual bond either fulfills the maturity criterion or does not fulfill. For all these reasons, I include the *Remaining maturity* variable to my regression formula and if anything, expect a negative relation with maturity and yield change.

Due to the high multicollinearity I decide to use fixed effects to control for non-time variable effects. I add fixed effects for country, sector and bond rating. Country and sector effects serve as additional controls. This improves the statistical power of the regressions because the country of domiciliation and the sector of the firm clearly affects the credit riskiness of the firm and thus the yield. The effect, however, is not limited to the level of the yield but country and sector have previously been found to affect the change of the yield after quantitative easing events by for example Zaghini (2017), Krishnamurthy et al. (2017), Altavilla et al. (2015) and Andrade et al. (2016).

Zaghini (2017) runs all the regressions with fixed effects for country, sector and issuer rating, to account for the different sources of heterogeneity in the European corporate bond market. The prior literature finds the quantitative easing to have a larger effect on the bonds initiated by companies that are from countries that possess more credit risk in general. Zaghini reports that average bond spread level varies across the countries a lot. Bonds originating from Germany had an average ASW spread of 146 basis points compared to Greece where the average ASW spread was 439 basis points. Krishnamurthy et al. (2017) and Altavilla et al. (2016) report that the announcement effect regarding OMT was significantly larger for the sovereign bonds of Italy and Spain compared to only a small effect on the sovereign bonds of the countries such as Germany and France. Andrade et al. (2016) also find the APP to have larger effect on Spanish sovereign bonds (17 to 32 basis points) compared to French sovereign bonds (14 to 19 basis points).

On the other hand, the bond rating fixed effects are added to reduce the biasedness of the regressions, specifically the multicollinearity between *Eligible dummy* and *IG dummy*. The coefficients of those variables were positively 93-95% correlated in the regressions without fixed effects. The introduction of the fixed effects for bond rating allows me to drop a previously used dummy variable for investment grade rating out of the regression and get rid of the multicollinearity and yet I can still control for the yield changes arising from the varying creditworthiness of the bonds.

My hypothesis is that the one- to six-day yield changes should reveal the announcement effect most accurately. Longer-term yield spread changes are naturally more likely to be disrupted by other events and thus biased by missing variables. Longer than thirty-day yield changes might also capture the effects of the actual purchases conducted by ECB and even the portfolio rebalancing effect that occurs when institutional investors rebalance their portfolios to match the pre-event yield-structures. The deltas of more than thirteen days should give us indication of the effects of actual purchases and portfolio rebalancing.

This regression formula is set up to fit the event study style of this paper. This econometric setup does not allow me to control for any time-fixed effects The intercept term of the formula should capture the part of the yield spread change that is common for all the bonds in the sample. I interpret this common term as the "general direction of the yield spreads" during a given event window. If the intercept term for the thirty-day time span for example is 0,15 that means the "general direction of the yield spreads" was 15 percentage points upwards no matter the characteristics of a given bond. On top of the intercept term is then added the coefficients of all the control variables multiplied by their respective values for a given bond, which results as the yield spread change of that given bond during that thirty-day time span.

5.3 Methods to study direct and portfolio rebalancing effects

I study the direct effects created by the actual purchases conducted by ECB to corporate bond yields. The analysis is done in three ways. Firstly, I gather the weekly data of ECB's portfolio holdings and divide bonds into three categories: "non-eligibles", "eligibles not bought" and "eligibles bought". Then I analyze whether the inclusion to the portfolio influenced the yield change patterns of the bonds in the latest category. Secondly, I form a dummy variable called "actually purchased dummy", which equals 1 if the given bond is included to ECB's portfolio after the first event (until the end of the year 2020) and 0 if not. I run multivariable regressions for multiple time windows after the initial announcement and analyze whether the inclusion to the portfolio has statistically significant effect on yield. Thirdly, I compare the time series of ECB's weekly net purchase volume and the coefficient of *Eligible dummy* over time, retrieved from the multivariable regressions.

I analyze the portfolio rebalancing effect with time series of *Eligible dummy* coefficients. This analysis will not yield conclusive results but will give us early indication of how the effect of eligibility has developed during the year 2020.

6 Results

6.1 T-tests show differences between the two samples after announcements

The Welch's two-sample t-test shows that the eligible and non-eligible samples have statistically significantly different mean yield changes in most events and event windows. As we can see from Table 2, the 6-, 30- and 50-day yield spread change means between eligibles and non-eligibles are significantly different after events two and three. The mean yield changes are not significantly different during any event window after the first event.

Eligible bond yield spreads decreased more in percentage terms after the second event. On the other hand, the eligible bond yield spreads increased more after the third event. Welch's t-test does not provide us any conclusive arguments for or against the hypothesis that eligible bonds should experience a relatively larger decrease in yield spreads after the events. First event is insignificant, second event supports the hypothesis, and third event is completely against it. Welch's t-test gives us mixed indication of the contribution of eligibility to the yield spread changes.

These results suggest that the *Eligible dummy*, which is used to divide the two samples, has something to do with the experienced yield spread changes after the events, but does not explain it very well alone. I need some other variables, besides the *Eligible dummy*, to control for the variation in yield spread changes. In the next subsection I report results for the multivariable regressions that should give us more insight about the underlying drivers of the yield spread changes.

Table 2

This table reports the results for Welch's two-sample t-tests when adjusting for the differences in sample variances. The three Panels (A to C) show results for three different time spans and three columns represent the three different announcement events. In every panel the first two rows show the mean returns for the eligible and non-eligible bond groups. The third row gives the t-value of the test and asterisk(s) after the t-value denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

Panel A. 6-day yield delta	**Event 1** *(March 18th, 2020)*	**Event 2** *(June 4th, 2020)*	**Event 3** *(December 10th, 2020)*
Eligible mean	32.9 %	-16.0 %	2.3 %
Non-eligible mean	29.7 %	-6.8 %	1.0 %
t-value	0.59	-13.13***	2.87***
Panel B. 30-day yield delta			
Eligible mean	23.2 %	-7.6 %	3.7 %
Non-eligible mean	11.9 %	0.6 %	-4.7 %
t-value	1.34	-7.54***	3.9***
Panel C. 50-day yield delta			
Eligible mean	12.5 %	-20.9 %	1.8 %
Non-eligible mean	11.7 %	-6.9 %	-5.5 %
t-value	0.1	-10.7***	3.77***

6.2 Multivariable regressions indicate that eligibility matters after announcements

In the Tables 3 and 4 below, I report the results for time spans of 1, 2, 3, 6, 13, 30 and 50 days for all the three events (event windows). The columns (1-3) represent the three PEPP events analyzed in this paper. The panels (A-C and A-D) represent the different event windows listed above. I predict that the announcement effect is most likely to show in the shorter time span regressions.

The results for eligibility are mixed between events, but relatively consistent within events. For the first event, the *Eligible dummy* is statistically significantly negative after one day after the initial announcement. The magnitude of the effect varies between -18,6% and -105%, showing an increasing pattern as the time goes on. Larger than -100% coefficients are possible due to the yield increasing effects of the coefficients of other control variables and intercept term. The second event shows also mostly negative coefficients for *Eligible dummy* although the results are not as significant as in the case of the first event. The magnitude is also lesser compared to the first event as this time the coefficient of *Eligible dummy* varies between -2,9% and -12,5% among the statistically significant data points. The third event tells a completely different story, where the eligibility has a significant and economically large positive effect on yield spread development. Every single time span shows highly significant coefficient for *Eligible dummy* while the magnitude of the yield spread change varies between 4,6% and 16,5% showing a slightly increasing trend by time.

Table 3

This table reports the multivariable regression result for all three events. Panels report the coefficients and t values (in parentheses) for every variable and for three different time spans (1-, 2-, and 3-day yield deltas). All dummy variables are equal to 1 if the bond fulfills the criterion and 0 if not. Maturity refers to the bond's Maturity left in days at the time of the event. Volume is initial bond volume in millions of dollars. Prior 5-day delta is the percentage yield change five days prior to the event. Fixed effects for country, sector and rating are included. Asterisk(s) after the t-value denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

	Event 1		**Event 2**		**Event 3**	
Panel A. 1-day yield delta	*(March 18th, 2020)*		*(June 4th, 2020)*		*(December 10th, 2020)*	
Intercept	0.010	(0,08)	-0.036	(-1,27)	-0.003	(-0,14)
Eligible dummy	-0.042	(-0,65)	-0.029	(-1,61)	0.095	(7,96)***
Maturity	-1.8E-05	(-3,37)***	5.0E-07	(0,42)	4.1E-06	(4,41)***
Already holding dummy	0.074	(3,27)***	-0.011	(-2,12)**	0.018	(4,49)***
Volume	5.5E-05	(2,38)**	-3.4E-05	(-6,52)***	4.5E-06	(1,08)
Prior 5 day delta	-0.005	(-0,45)	0.030	(5,33)***	-0.007	(-0,64)
	R^2= 4% / F = 2,2		R^2= 11% / F = 5,0		R^2= 12% / F = 5,2	
Panel B. 2-day yield delta						
Intercept	0.063	(0,34)	-0.010	(-0,24)	0.031	(1,37)
Eligible dummy	-0.211	(-2,19)**	0.007	(0,26)	0.059	(4,85)***
Maturity	-1.6E-05	(-2,07)**	4.2E-06	(2,41)**	4.7E-06	(4,84)***
Already holding dummy	0.126	(3,78)***	-0.050	(-6,38)***	0.015	(3,63)***
Volume	7.6E-05	(2,25)**	-5.6E-05	(-7,21)***	-1.3E-05	(-3,12)***
Prior 5 day delta	0.017	(1,08)	0.077	(9,28)***	0.012	(3,92)***
	R^2= 4% / F = 2,3		R^2= 26% / F = 12,1		R^2= 12% / F = 5,0	
Panel C. 3-day yield delta						
Intercept	0.066	(0,38)	-0.067	(-1,75)*	0.067	(2,30)**
Eligible dummy	-0.274	(-3,05)***	-0.076	(-3,17)***	0.051	(3,25)***
Maturity	-3.5E-05	(-4,85***	4.3E-06	(2,70)***	3.2E-06	(2,58)***
Already holding dummy	0.108	(3,49)***	-0.072	(-10,4)***	0.019	(3,42)***
Volume	6.8E-05	(2,15)**	-6.4E-05	(-9,16)***	-2.4E-06	(-0,44)
Prior 5 day delta	-0.013	(-0,90)	0.042	(5,66)***	0.050	(3,20)***
	R^2= 6% / F = 3,0		R^2= 34% / F = 17,4		R^2= 4% / F = 2,1	

Table 4

This table reports the multivariable regression result for all three events. Panels A-D report the coefficients and t values (in parentheses) for every variable and for four different time spans (6-, 13-, 30- and 50-day yield deltas). All dummy variables are equal to 1 if the bond fulfills the criterion and 0 if not. Maturity refers to the bond's Maturity left in days at the time of the event. Volume is initial bond volume in millions of dollars. Prior 5-day delta is the percentage yield change five days prior to the event. Fixed effects for country, sector and rating are included. Asterisk(s) after the t-value denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

	Event 1		**Event 2**		**Event 3**	
Panel A. 6-day yield delta	*(March 18th, 2020)*		*(June 4th, 2020)*		*(December 10th, 2020)*	
Intercept	0.073	(0,34)	-0.047	(-1,31)	0.017	(0,52)
Eligible dummy	-0.186	(-1,66)*	-0.029	(-1,26)	0.046	(2,52)***
Maturity	-4.2E-05	(-4,72)***	2.7E-06	(1,79)*	6.7E-06	(4,64)***
Already holding dummy	0.109	(2,82)***	-0.068	(-10,3)***	0.040	(6,43)***
Volume	9.4E-05	(2,42)**	-4.3E-05	(-6,50)***	3.5E-06	(0,54)
Prior 5 day delta	-0.013	(-0,71)	0.011	(1,55)	0.045	(2,51)***
	R^2= 5% / F = 2,8		R^2= 34% / F = 17,2		R^2= 14% / F = 6,0	
Panel B. 13-day yield delta						
Intercept	0.279	(1,18)	-0.025	(-0,54)	-0.023	(-0,48)
Eligible dummy	-0.542	(-4,48)***	-0.125	(-4,26)***	0.165	(6,31)***
Maturity	-5.7E-05	(-5,87)***	5.7E-06	(2,93)***	5.2E-06	(2,49)**
Already holding dummy	0.107	(2,56)***	-0.063	(-7,35)***	0.041	(4,47)***
Volume	2.9E-05	(0,67)	-5.2E-05	(-6,07)***	3.2E-06	(3,45)***
Prior 5 day delta	-0.072	(-3,73)***	0.045	(4,94)***	0.076	(2,94)***
	R^2= 8% / F = 4,0		R^2= 28% / F = 13,1		R^2= 10% / F = 4,5	
Panel C. 30-day yield delta						
Intercept	0.262	(0,97)	-0.087	(-1,64)	0.046	(0,71)
Eligible dummy	-1.051	(-7,54)***	-0.063	(-1,89)*	0.094	(2,65)***
Maturity	-6.0E-05	(-5,34)***	5.0E-06	(2,29)**	-6.1E-06	(-2,17)**
Already holding dummy	0.035	(0,73)	-0.032	(-3,35)***	0.051	(4,11)***
Volume	-8.6E-05	(-1,75)*	-1.0E-05	(-1,07)	-1.0E-05	(-0,80)
Prior 5 day delta	-0.059	(-2,65)***	0.022	(2,12)**	0.136	(3,91)***
	R^2= 13% / F = 5,8		R^2= 14% / F = 6,0		R^2= 7% / F = 3,3	
Panel D. 50-day yield delta						
Intercept	0.434	(1,52)	-0.098	(-1,57)	-0.154	(-1,77)*
Eligible dummy	-0.887	(-6,07)***	-0.003	(-0,07)	0.084	(1,76)*
Maturity	-4.4E-05	(-3,78)***	1.7E-05	(6,59)***	1.6E-06	(0,42)
Already holding dummy	0.006	(0,12)	-0.076	(-6,72)***	0.074	(4,51)***
Volume	-1.5E-04	(-2,94)***	-6.0E-05	(-5,22)***	1.9E-05	(1,11)
Prior 5 day delta	-0.078	(-3,35)***	0.004	(0,30)	0.304	(6,51)***
	R^2= 9% / F = 4,4		R^2= 24% / F = 10,7		R^2= 10% / F = 4,4	

The other variables included in the regression are for control purposes only and are not of interest themselves. However, it is noteworthy that for many variables the signs of the coefficients do variate between events and in some cases even within events. In fact, there is not a single variable that would show consistent results in terms the direction of the effect across events and event windows. I find this to be both interesting and unexpected. This could be mainly caused by the volatile and high-stress environment that persisted the whole year. Another reason for mixed results could also be that the variables have only limited effect on the yield spread change and that I am missing important variables (omitted variable bias). This second argument is supported by the relatively low explanatory power (adjusted R-squared) of the regressions.

Remaining maturity has fairly consistent and highly significant coefficients in the regressions within events. Remaining maturity has yield decreasing effect after the initial announcement and yield increasing effect after the other two announcements. This means that the markets preferred longer remaining maturities after the initial PEPP announcement but later on reverted back to shorter remaining maturities. As stated earlier, remaining maturity should not in theory have a huge effect on the yield spread because the yield spread variable is itself "maturity-corrected". However, as the Remaining maturity is also one of the eligibility criteria, the variable is not only linear but also binary. A given bond either fulfills the maturity criterion or does not.

I find no systematic signs of any pre-announcement information leakage, insider trading or markets predicting the announcement effects. The correlation between the prior five-day yield spread change and post-announcement yield spread change is negative for the first event and positive for the second and third event. More in-depth analysis would need to be conducted to study more the very short-term (intra-day) market behavior around the announcements.

6.3 Actual purchases decrease the spreads even more, creating direct effect

I study the direct effect of actual purchases conducted by ECB to corporate bond yields with three methods as described in the previous section. The results suggest that actual purchases do in fact decrease not only the yields of the eligible bonds that are being purchased but also the yields of all eligible bonds as a sample group. However, the latter cannot be conclusively studied with my methods.

The bonds that were included in ECB's portfolio during a given week (N=30) experienced a 0.73 percentage point drop in yield compared to other eligible bonds during the same time period. On the other hand, the bonds that were dropped from the portfolio (N=107) increased in yield on average by 1.33 percentage points more than other eligible bonds. Over time, I weight the averages based on the number of bonds in each category. There was between 621 and 646 eligible bonds every week that stayed either in or out of the portfolio, which means that ECB did neither include nor exclude them from the portfolio. This analysis suggests that the actual purchases and sells conducted by the ECB affected the spreads.

The analysis has a couple of caveats. Firstly, the data sample for bought and sold bonds is very limited (Nb=30 & Ns=107) compared to the number of bonds that remained unchanged (either in or out of the portfolio, N = 621 to 646 per week). Small sample will of course decrease the statistical power of the analysis. Secondly, I only have weekly datapoints which forces me to use weekly yield spread changes as the variable of interest. I do not know exactly which day during a given week a bond is either bought or sold but what I do know is that the transaction happened during that week. It would be even more interesting to analyze the intra-day change after the actual transaction. Thirdly, my data is binary, meaning that ECB's portfolio either contains a given bond or does not during a given week. There is no information about the volume of that bond in the portfolio. This forces us to define "buying and selling" as "adding a bond in the portfolio" and "dropping a bond from the portfolio". Therefore "remained unchanged" -category might include some bonds that ECB dropped partly from the portfolio or bought more to the portfolio. There should be more “positive partial adjustments” (ECB bought more of a certain bond) than “negative partial adjustments” during times positive net purchase times. In theory this could cause predictable bias to the analysis. If this is true, the yield difference between “bought bonds” and “bonds that remained unchanged” is actually larger than it appears in my analysis and the difference between “sold” and “remained unchanged” is actually smaller than it appears.

Based on the analysis, the bonds that ECB actually included in their portfolio experienced by far the most significant decrease in yield spread during the year 2020. Graph 7 reports the yield spread changes for three sample categories in relation to time after the first PEPP announcement in March 2020. During the year 2020, non-eligible bonds decreased on average 46% in yield spread, eligible bonds that were not being bought decreased on average 52% and eligible bonds that ECB did buy decreased in yield spread 65% on average. The difference in yield change between eligible bonds that are not bought and eligible bonds that are actually bought is statistically significant 30 days after the first event. After that, the difference grows both in size and significance. The caveats here are the same as earlier: The sample for actual purchases is very small and ECB reports only the purchases that are new inclusions to the portfolio.

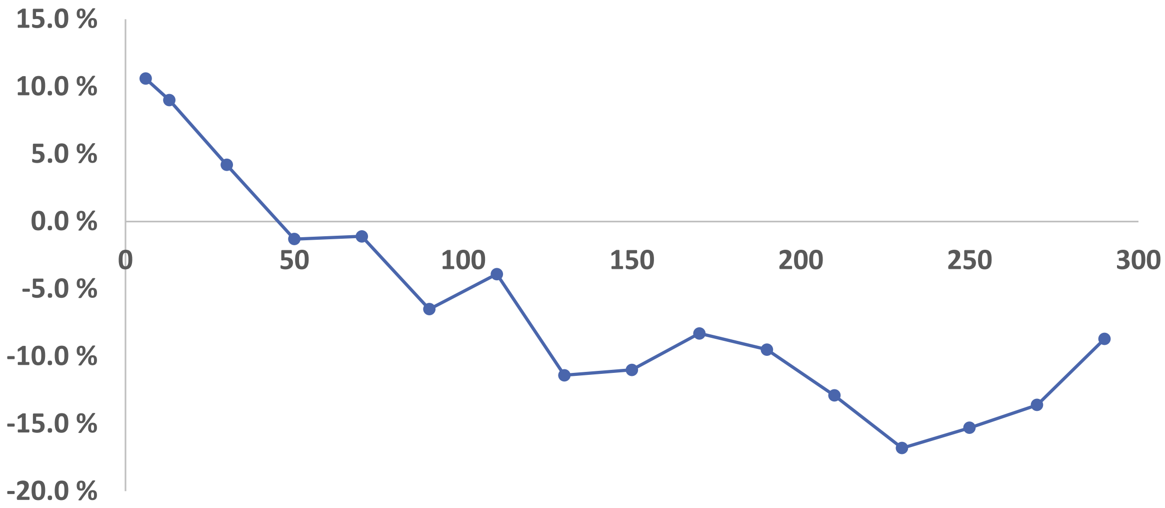
Graph 7

Median yield change, eligibility and actual purchases. Horizontal axis indicates calendar days after the initial announcement starting from 5 days prior to the announcement (18th of March 2020).

For the purposes of the second analysis, I add a dummy variable representing the bonds that were actually purchased by ECB between the March and December announcement. The regressions here are ran the same way as earlier when studying the effect of eligibility in case of the first event. In practice this is an extended version of the regression I ran when studying the announcement effect of the initial PEPP announcement, with one additional variable (*Actual purchase* -dummy). I report the coefficients of the new dummy variable, which should capture the effect of an actual purchases, in the Graph 8 below and in the form of a modified regression table in Appendix (Table A). Every unique datapoint tells us how big of an impact the actual purchases had during a given time period. For example, the effect of being purchased was decreasing the yield spread -6,5% in the 90-day regression. There is a clear decreasing trend in the graph, but the individual coefficients are not statistically significant. I suspect this is because the sample size of the actually purchased bonds is small. It seems that the actual purchases had a yield decreasing effect even though the effect is not statistically significant.

Graph 8

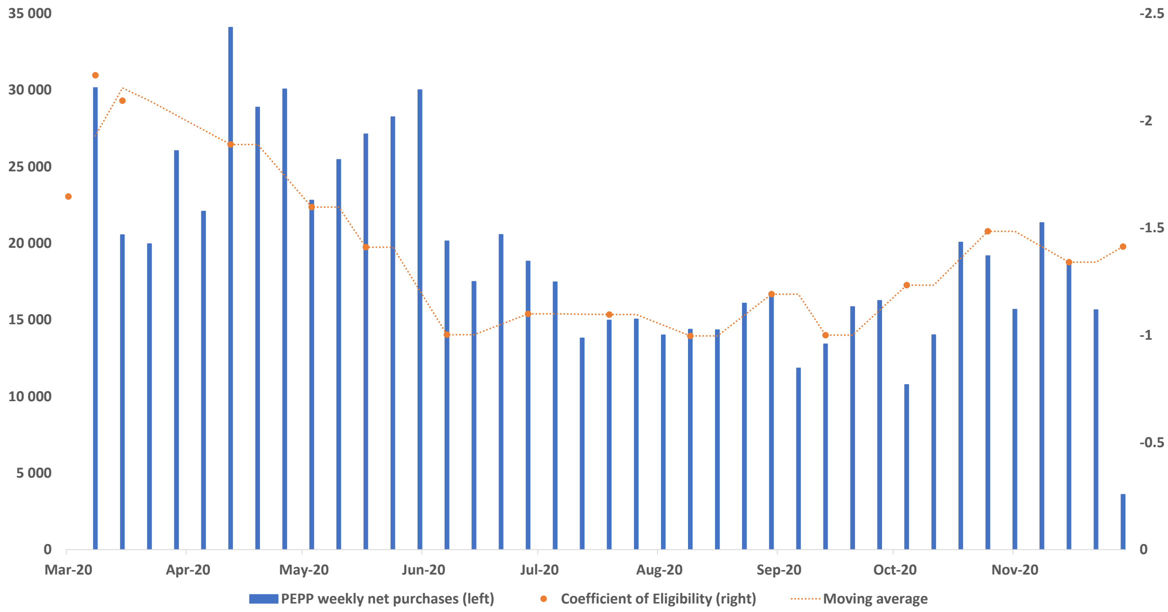
Coefficient of Actual purchase dummy during 2020. Horizontal axis indicates calendar days after the initial announcement starting from the announcement date (18th of March 2020).



As the Graph 9 below shows, weekly net PEPP purchases seem to be correlated with the yield spread changes. The coefficient of eligibility in the multivariate regressions decreases when there is only small number of purchases and increases again when the ECB conducts more purchases. The effect is not as viable in the raw yield change level, which is not surprising since the raw yield change analysis does not account for any differences in the bond characteristics. The coefficient of *Eligible dummy* should measure accurately the pure effect of eligibility and that seems to be linked to the level of actual weekly purchases. I report a modified regression table of the coefficients of *Eligible dummy* in the Appendix (Table B).

Graph 9

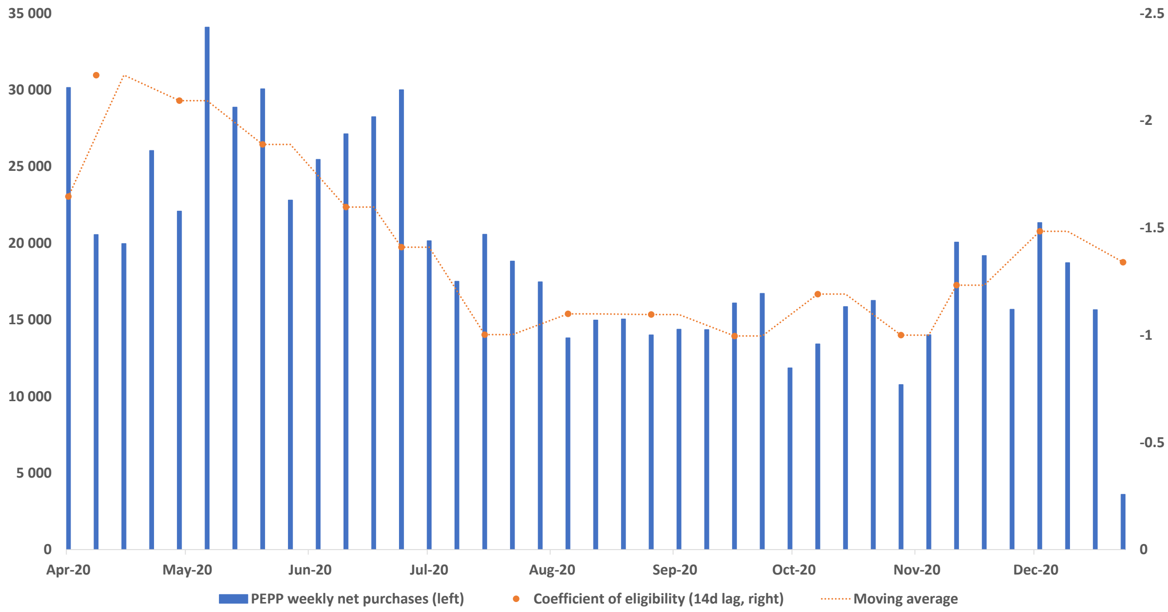
PEPP weekly net purchases (in M€) and coefficient of Eligible Dummy.



The correlation between PEPP purchases and the coefficient of *Eligible dummy* is even more drastic when the coefficient of *Eligible dummy* is lagged by two weeks. I report this in the Graph 10 below. It takes ECB at least a week to report their purchases and thus the "behavioral effect" of the purchases to the yield level is naturally lagging more than a week. The instant effect occurs when ECB conducts the purchases and increases the demand for those bonds. The "behavioral effect" could represent how the markets view the scale and scope of the conducted purchases. The scale of the weekly net purchases varies between 4 and 34 billion euros. The scope of the purchases could for example reveal some information about the bonds that ECB is most likely going to be purchasing in the future. ECB has the right to purchase bonds that they already have in their portfolio as well as add new bonds. The purchases can also be done via primary or secondary markets. This type of information is likely to alter the yields of eligible bonds via changing expectations of the future purchases.

Graph 10

PEPP weekly net purchases (in M€) and a 14-day lagged coefficient of Eligible Dummy.



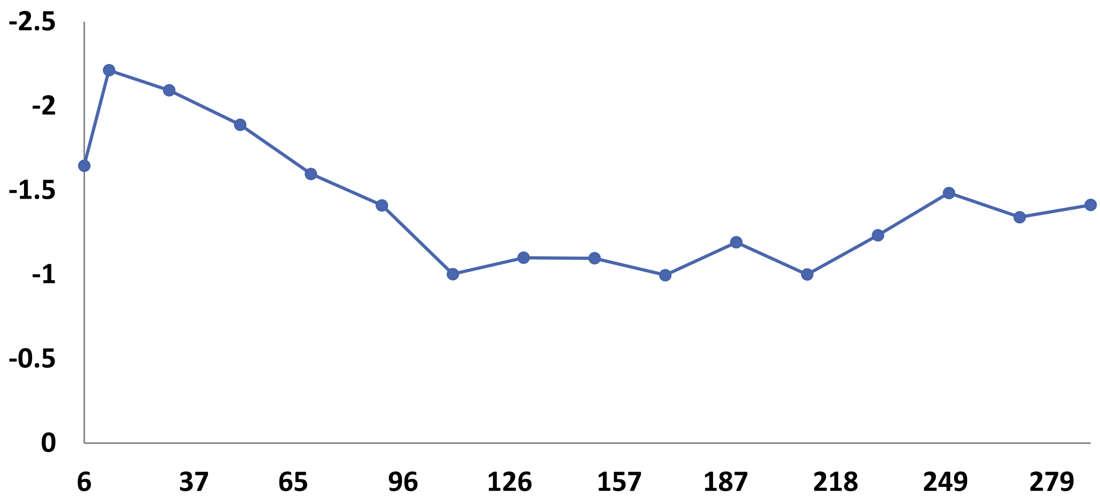
6.4 *Evidence of portfolio rebalancing in the medium term*

Analyzing the coefficient of the *Eligible dummy* in the regression gives us indication of how the effect of eligibility varies over time. I report the coefficient of *Eligible dummy* in the Graph 11 below. This is exactly the same regression as earlier when studying the announcement effect of the initial announcement, except this time the time period is extended to the end of year 2020 to capture the longer-term effect. The pool of bonds in these regressions is a subsample of the full sample, because of the longer remaining maturity required as of initial PEPP announcement. The sample of bonds is kept the unchanged for the full period of 290 days, which of course sets the lower limit for required remaining maturity at the time of the first event to 290 days. A decreasing coefficient would be in line with the hypothesis that the portfolio rebalancing channel decreases the effect of eligibility by closing the spread change difference between eligible and non-eligible bonds (*Hypothesis 3*). The increased demand for eligible bonds is assumed to push the eligible bond prices up while decreasing the yield spread. Yield-seeking investors should in theory increase their exposure to other riskier asset categories, including riskier bonds with similar duration, which should in theory close the spread change gap between those two samples.

In the medium term, between 13 to 110 days after the initial PEPP announcement the spread change gap seems to close. The effect of eligibility decreases by more than fifty percent during that time period although after that flattens and does not convert even close to zero. All the coefficients are statistically significant at least at 10% level. The significance is even higher before the "flattening of the curve": The first eight coefficients are all significant at 1% level. This trend in the coefficient could of course be related to the actual purchases conducted by ECB as discussed in previous section or be a combination of the two forces (direct and portfolio rebalancing effects).

Graph 11

Coefficient of Eligible dummy during 2020.



7 The robustness and limitations of the results

7.1 Multicollinearity

Multicollinearity caused some major bias in my regression results before I modified the regression formula. The problem was the correlation between *Eligible dummy* and *IG dummy*. The correlation coefficient between those two variables was consistently between 93 and 95 percent in the regressions. This problem arose from the very nature of *Eligible dummy*: for a bond to classify as “eligible” it had to fulfill all three eligibility criteria; maturity, credit rating and volume. Most of the investment grade bonds in my sample did also fulfill the maturity and volume criteria, which lead to high correlation between *Eligible dummy* and *IG dummy*.

It is necessary to keep some variable controlling for the credit rating of a bond, to find the effect of “eligibility” not the effect of being investment grade, with the *Eligible dummy*. The combination of three successful criteria fulfillments is interesting, not the individual variables. By just excluding the *IG dummy* from the regression formula, I would have gotten rid of the multicollinearity, but the results would have been otherwise biased. The lack of *IG dummy* would have caused omitted variable bias and ultimately biased the coefficient of *Eligible dummy* and possibly the coefficients of other variables too.

Zaghini (2017) experiences the same multicollinearity problem where investment grade and eligible dummies are highly correlated. The solution chosen by Zaghini is to exclude investment grade dummy from the baseline regressions and rather control for the bond grade with fixed effects. I follow this method by creating a dummy variable for each bond rating ranging from AAA to CC (20 variables). Each of the dummy variables should capture the contribution of that rating to the spread change and thus allow us to observe the combination of the three eligibility criteria in the form of the *Eligible dummy*. Now the regressions are free of multicollinearity and should not be biased in that way.

7.2 Omitted variable bias

The explanatory power of my baseline multivariate regressions is not the greatest, ranging from 4 to 34 percent, as we can see from the Tables 3 and 4 presented in the Results section. This suggests that the results could be affected by omitted variable bias. Including fixed effects for countries, sectors and credit ratings enhances the explanatory power of the regressions a bit. This might mean that I have managed to get rid of some of the omitted variable bias in my regressions. An interesting caveat here is that the explanatory power of the regressions seems to increase from the very shortest time periods to the medium terms. The multivariate regressions reach peak adjusted r-squares between three- and thirty-day time periods and then revert to smaller levels of explanatory power. A similar trend can be seen in the longer-term analysis that I conduct when analyzing the portfolio rebalancing effect. The explanatory power peaks in the 50-day regression and then decreases slowly but steadily until hitting the bottom in the 290-day regression. This indicates that there likely are additional unknown and omitted variables in the longer-term analysis. Naturally, as the time goes on, many additional events and variables affect the bond yields and thus bias my analysis. That said, the shortest time periods are less likely to be affected by this issue, even though the explanatory power of those is not the greatest.

7.3 Outdated control variables

One of the major limitations of my analysis is related to the fact that I was not able to get time-series data of bond ratings. I use the latest 2020 rating available for individual bonds. The primary rating agency is Fitch, but I use Standard & Poor's or Moody's data in case Fitch rating is not available for a given bond. This makes my analysis and regressions vulnerable for the changes in the credit ratings. This limitation is not a problem in case the individual bonds' ratings change inside high yield or investment grade class.

The real issue is when a bond rises to or falls from the investment grade category during the time window of this study. For example, if a bond used to have a BB+ (high yield) rating from March to September and in September managed to get a BBB (investment grade) rating, my analysis is biased for the events one and two. This should not be as large of a problem the other way around (for fallen angels) because my credit rating is the most recent observation in 2020.

This issue is most significant in a case that ECB's purchase program causes a high yield bond to rise from high yield to investment grade class. This would cause endogeneity bias to my analysis via measurement error in independent variable. Unlike the other issues discussed earlier, there is basically nothing I can do for this. The only solution for this outdated control variable issue would be to do the analysis with a more complete dataset.

7.4 Size of the issuing company and linearization of bond rating

My results are robust to various changes in the regression formula. I report the regression results with additional control variables such as *Log total assets* and *Linear rating*. The former is a natural logarithm of the issuing firm's total assets. This variable intends to control for the differences in the size of the issuing firm. While the size of the issuing firm is highly likely to affect the level of the yield spread, I find no reason for it to affect the change of the yield spread over time. *Linear rating* is simply a linearization of the bond ratings. The worst rating (CC) is assigned a value of 1 and the best rating (AAA) a value of 20. I report modified regression tables for these robustness checks in the Appendix (Tables C & D).

Adding the control variable for size (*Log total assets*) has virtually no effect on the regression results in terms of the coefficient of *Eligible dummy*. The sign of the coefficient stays unchanged, and the magnitude of the effect remains almost unchanged. *Log total assets* is itself mostly insignificant and has no economically sizable effect on the yield spread change either. The linearization of the bond rating does not change the outcome of the regressions drastically. The signs of the coefficients for *Eligible dummy* remain the same, although the magnitude of the effect of eligibility is smaller in the case of the first event. *Linear rating* has a negative coefficient as predicted: A quality rating results in a more negative yield spread change after every PEPP announcement.

8 Discussion

8.1 Announcement effect is large and significant but relatively slow

Even though just a few actual purchases occurred during the first days after the events the announcement effect was relatively large. This announcement effect indicates that the markets do trust ECB to conduct all the purchases and improve the liquidity and financing conditions of the European bond markets.

However, the market reaction to the PEPP announcements is fairly slow. In government bonds the reaction to policy rate changes or quantitative easing actions is known to be very fast and effective because of the high liquidity of the public bonds. For example, Altavilla (2015) and Andrade (2016) report significant intra-day reactions for the PSPP announcements. I do not have intra-day data to explore this, but my results indicate that it takes one to three days for the changes to be visible from the yield spreads.

8.2 Direct effect seems sizable and significant

My results indicate strongly that a somewhat significant and sizable direct effect occurs when ECB conducts the purchases of eligible bonds. I document this effect to be true for both the eligible sample as a whole and especially for the eligibles that are included in the ECB's portfolio.

The prior literature around direct effects (also called flow effects) is mixed about the significance of it. Andrade et al. (2016) find a significant and economically large announcement effect but do not identify any statistically significant direct effects when the actual purchases of eligible bonds were carried out. Zaghini (2017), on the other hand, reports no significant announcement effect but concludes that the direct effect was visible for nine months after the CSPP announcement.

However, as mentioned earlier, further work regarding direct and portfolio rebalancing effect is needed to learn more about the effects. Especially the direct effect should be studied more exhaustively when more data of the actual purchases has been gathered. I also suggest a more technical analysis of this subject later on when more primary data is available.

8.3 No convincing evidence of portfolio rebalancing

I find some evidence supporting the rebalancing theory, but the results are all but conclusive. The coefficient of eligibility trends towards zero for a while after the first event but then settles down and eventually even becomes larger again. First, we need to ask ourselves how large should the effect be for the rebalancing channel to be considered as “active”?

As discussed already in the literature review section of this paper, the “ideal and pure” rebalancing effect occurs when the markets are perfectly efficient, and investors can easily make the transition to assets with higher credit risk, while not changing the other risk components. In practice there might not be perfect alternatives with all the similar characteristics. This market imperfection is likely to result in segmented markets and investors not rebalancing their portfolio as central banks intended. The investors most likely cannot do any rebalancing without transaction costs, which is another deviation from the perfect world. Therefore, it might not be reasonable to expect “perfect rebalancing” i.e., the coefficient of eligibility converting all the way to zero. Maybe the flattening of the coefficient curve to the level of -100% is as close to zero as it is reasonable to expect.

At least two arguments can be had to argue that my results do not accurately report the actual effect. The coefficient of *Eligible dummy* might be mostly random noise after three months after the first event. The market volatility and stress at the time was so high and important news came out every single day that it is very hard to argue for causality for longer periods of time. This random noise argument could explain why the decreasing trend in the coefficient is so evident for three months but then seems to disappear.

Another reason why the results are neither conclusive nor convincing could be that the effect has not yet fully occurred. Some prior studies find the rebalancing effect to be very slow and easily disrupted by other effects. Hancock and Passmore (2011) find that rebalancing had its greatest importance only after the Fed’s MBS purchase program ended but while they still held on to the purchased assets. They also admit that the rebalancing effect might be disrupted by the “stock effect”, which I call the direct effect. During the purchase program, the central bank is buying the assets, which is likely to increase the yield change difference. At the same time, the rebalancing effect should do work to the other way and close the gap. Therefore, it is very hard to distinguish those effects and determine the real magnitude of each effect before the purchase program has ended. Here, I suggest a more thorough and technical analysis of the portfolio rebalancing effect in case sufficient data becomes available. Andrade et al. (2016) does great work examining the portfolio rebalancing channel during ECB’s Asset Purchase Program (APP).

8.4 Why are the results so different for the third event?

The most likely reason for the third event yielding so different results is that other news might have affected the yield spread development. Any other news could of course increase the magnitude of PEPP’s announcement effect on yields or work the opposite direction and mute the effect or even make it of an opposite sign. There were no other ECB announcements on March 18th (initial announcement). On June 4th (second announcement), ECB also announced the continuation of APP and decided to keep the policy rates unchanged. Here we all must remember that even “no action” or “keeping something unchanged” can be reflected in prices since everything is measured against the expectations. However, it is likely that none of these other announcements had any significant effect on the corporate bond yields.

The story is very much different in the case of the third PEPP announcement on December 10th. In addition to PEPP, ECB announced the continuation of APP, keeping policy rates unchanged and making changes to TLTRO3 program, PELTROs and EUREP. Intra-day yield data would allow us to estimate the magnitude of each announcement separately, but at this point it is unclear how large these other effects were. In addition to the monetary policy announcements, ECB also disclosed a set of forecasts during the Governing Council Press Conference. Christine Lagarde, the President of ECB, among other things announced that “the outlook for economic activity has been revised down in the short term from the September baseline scenario". In practice this announcement meant that ECB had significantly reduced the headline inflation estimates for the future from the previous estimates disclosed in September. I have every reason to believe that some combination of all these announcements must have affected the yield spreads of corporate bonds and given the nature of the announcements the direction of the effect is likely to be yield increasing.

Another factor separating the third event from the previous two is the overall economic stress level. During the third event Europe experienced way lower levels of systemic stress compared to the first two events, which might have decreased the effectiveness of the expansion and extension of the program in December 2020. (See Graph 2 about the CISS in EU and US)

Prior literature agrees that countries experiencing higher stress levels and economic distress are more affected by the quantitative easing or bond purchases in general. For example Zaghini (2017), Krishnamurthy et al. (2017), Altavilla et al. (2015) and Andrade et al. (2016) reported louder effects for the Mediterranean countries compared to France and Germany. Altavilla et al. (2015) concludes that large impact on asset prices has historically been produced only during high economic distress. Krishnamurthy and Vissing-Jorgensen (2011 and 2013) and D'Amico and King (2012) find this to be the case in recent US monetary policy history too.

As we all know, the Mediterranean countries such as Spain, Portugal and Greece were significantly more distressed during the launches of OMT and APP. It could very well be that QE is also more effective during economically worse times compared to more normal times, which the third event represents. Quantitative easing helps distressed companies to secure funding, and during worse times there exists more distressed companies in need of help. The default risk channel is likely to be less effective during better economic conditions and the liquidity channel could also be more muted since the assets are more liquid to begin with.

9 Summary

This paper provides an early assessment of the effects of ECB's Pandemic Emergency Purchase Program on European corporate bond yields. The three effects studied and discussed in this paper are the announcement effect, direct effect, and portfolio rebalancing effect. I find significant evidence that being eligible to the Pandemic Emergency Purchase Program contributes decreasingly to the corporate bond yields after the initial announcement in March 2020 and after the second announcement in June 2020. The effect after the initial announcement is also economically very large (-27% in three days) compared to the effect after the second announcement (-8%). However, eligibility seems to have a significant yield increasing effect after the third PEPP announcement in December 2020 (+5%). This is likely due to lower economic stress environment and other simultaneous announcements. Due to mixed but significant results, I cannot reject the first null hypothesis nor the first alternative hypothesis that I present in section 3.5.

My results also suggest that the actual purchases conducted by ECB could have further on widened the yield change gap between eligible and non-eligible bonds. However, I find no statistically significant evidence to support the second hypothesis, which predicts that the purchases would further on widen the yield spread change gap between the two samples. My results indicate that the individual bonds, that are being purchased, are better off. The sample of bonds that ECB bought during 2020 decreased in yield spread 65% on average during the year 2020. This is significantly more than the yield spread decrease of "eligible but not bought" bonds (52%) and non-eligible bonds (45%). The coefficient of the dummy variable tracking purchased bonds is 1-17% negative after the start of the purchases, yet not significant. I find no evidence to support the third hypothesis, which predicts that portfolio rebalancing effect would close the yield change gap created by the other two effects.

Overall, the results are very much mixed but suggest that eligibility matters after all the announcements and after the purchases conducted by ECB. Further research is obviously needed to confirm the results of this paper, to explore the phenomenon in the primary bond markets and to examine the direct and portfolio rebalancing effects in more detail in the longer term.

Appendix

<u>Table A</u>

I report the coefficients of Actually purchased dummy and t-values. Asterisk(s) after the coefficient denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

Panel A. Coefficient of Actual puchase dummy		
6-day	10.60 %	(2.13)*
13-day	9.00 %	(1.19)
30-day	4.20 %	(0.56)
50-day	-1.30 %	(-0.19)
70-day	-1.10 %	(-0.15)
90-day	-6.50 %	(-0.79)
110-day	-3.90 %	(-0.46)
130-day	-11.40 %	(-1.60)
150-day	-11.00 %	(-1.46)
170-day	-8.30 %	(-0.95)
190-day	-9.50 %	(-1.10)
210-day	-12.90 %	(-1.45)
230-day	-16.80 %	(-1.90)
250-day	-15.30 %	(-1.66)
270-day	-13.60 %	(-1.37)
290-day	-8.70 %	(-0.67)

Table B

I report the coefficients for Eligible dummy and t-values. Asterisk(s) after the coefficient denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

Panel A. Coefficient of Eligible dummy		
6-day	-1.65	(-3.93)***
13-day	-2.21	(-5.38)***
30-day	-2.09	(-5.00)***
50-day	-1.89	(-4.45)***
70-day	-1.60	(-3.64)***
90-day	-1.41	(-2.97)**
110-day	-1.00	(-2.06)*
130-day	-1.10	(-2.74)**
150-day	-1.10	(-2.50)*
170-day	-1.00	(-1.89)
190-day	-1.19	(-2.35)*
210-day	-1.00	(-1.89)
230-day	-1.23	(-2.44)*
250-day	-1.48	(-2.77)**
270-day	-1.34	(-2.31)*
290-day	-1.41	(-1.84)

Table C

I report the coefficients of Eligible dummy and Bond rating. I run these regressions with linear bond rating as a control variable. The columns represent the coefficients of the two variables of interest and the rows the different regressions that differ in time period from one to fifty days. Otherwise, the regressions are exactly as described in Section 5. Asterisk(s) after the coefficient denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

	Event 1	
	Eligible dummy	**Bond rating**
1-day	-2.69 %	-0.11 %
2-day	-3.29%*	-0.33 %
3-day	-5.94%*	-0.08 %
6-day	-9.95%***	-1.02 %
13-day	-7.48%**	-0.60 %
30-day	-13.33%***	-3.65 %
50-day	-8.05 %	-3.19 %
	Event 2	
	Eligible dummy	**Bond rating**
1-day	-0.61%	-0.17 %
2-day	-3.27%*	-0.12 %
3-day	-4.42%***	0.12 %
6-day	-3.70%***	-0.07 %
13-day	-7.52%***	-0.15 %
30-day	-9.30%***	0.37 %
50-day	-9.85%***	-0.20 %
	Event 3	
	Eligible dummy	**Bond rating**
1-day	1.42%*	-0.09 %
2-day	1.01%**	-0.43%***
3-day	1.36%**	-0.32%**
6-day	1.23%*	-0.45%***
13-day	3.72%*	-0.51%**
30-day	2.67%*	-0.22 %
50-day	4.02 %	-0.42 %

Table D

I report the coefficients of Eligible dummy and Log Size (Total Assets). The columns represent the coefficients of the two variables of interest and the rows the different regressions that differ in time period from one to thirty days. Otherwise, the regressions are exactly as described in Section 5. Asterisk(s) after the coefficient denote the statistical significance at 5% (*), 1% (**) and 0.1% (***) level. All time periods are in calendar days.

	Event 1	
	Eligible dummy	**Log Size**
1-day	-9.79%	-0.01 %
2-day	-27.31%*	0.20 %
3-day	-36.84%***	1.68 %
30-day	-124.1%***	-0.37 %
	Event 2	
	Eligible dummy	**Log Size**
1-day	0.45%	-0.34 %
2-day	-2.36%	-1.16%**
3-day	-7.63%**	-1.36%***
30-day	-9.55%**	2.07%***
	Event 3	
	Eligible dummy	**Log Size**
1-day	3.57%**	-0.22 %
2-day	7.86%***	-0.04 %
3-day	3.57 %	0.01 %
30-day	6.82 %	-0.22 %

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